4.0 MANAGEMENT OPTIONS

The purpose of the Management Options Report is to identify and evaluate management techniques and strategies that could be implemented in response to observed or expected problems in the Estero Bay Watershed. This chapter presents a discussion of certain management approaches or tools, that could be implemented alone, or in combination, to achieve the nutrient loading, runoff, or wetland protection goals in the Estero Bay Watershed. These approaches are listed below.

- Require Greater Stormwater Attenuation and Treatment
- Designate Nutrient Sensitive Basins and Permit Accordingly
- Require Demonstrated Concurrency with Loads Reduction
- Construct Regional Treatment Facilities at Strategic, Basin-Nodes
- Require Buffer Areas around Tributaries
- Require Upland Buffers/Components for Wetlands
- Promote Best Management Practices (BMPs)
- Preserve and/or Restore Regional Flowways (hydrologic and habitat corridors)
- Transfer Development Rights from Sensitive Areas
- Require Demonstrated Concurrence With Listed Species Recovery

Options related to nutrient and sediment loading and runoff or hydrologic loading are described and evaluated in Table 4.1. These are primarily corrective actions. Options related to wetlands at risk are described and evaluated in Table 4.2. These are primarily conservation actions. There is some overlap between the corrective and conservation groups.

In addition to being divided into corrective and conservation, the options can be further classified as having the components outlined here.

A) Corrective
- Permitting practices
- Structural and active treatment
- Best management practices
- Monitoring

B) Conservation
- Restoration
- Preservation
- Compensation

Table 4.1 Management options for water quality and runoff problems in the Estero Bay Watershed.

Management Option	Issues Addressed	Mode of Operation	Constraints to Implementing	Potential Benefits
Require greater stormwater attenuation and treatment for private developments	Nutrient and sediment loading, runoff	Treatment improves stormwater quality, attenuation limits runoff	Cost, land requirements	Decreased loadings from stormwater
Designate nutrient sensitive basins and permit accordingly	Nutrient loading	Additional treatment in priority basins	Cost of additional treatment	Decreased nutrient loadings
Require demonstrated concurrency with loads reduction	Nutrient and sediment loading, runoff (hyrdologic loading)	Appropriate treatment and attenuation by new or modified projects	Cost of additional treatment	Decreased loadings from stormwater
Increase level of reuse for landscape irrigation	Urban water supply	Reuse reduces additional water use and nutrient loading	Reuse distribution systems, public acceptance	Reduces demands on aquifers and nutrient loading
Increase stormwater runoff storage near coast (regional treatment facilities)	Hydrologic alteration	Surface water is stored and gradually released	Cost, land requirements	Ensures stable, natural freshwater inflows for coastal estuary.
Provide for sheet flow of surface water past roads and utility corridors	Flooding, runoff rates, hydrologic loading	Improves surface water flow patterns and rates	Cost, regulatory/ enforcement	Improved surface water flow regime
Re-establish hydrologic connection for mined areas	Shell and fill mining	Increases areas that contribute stormwater runoff to estuary	Physical, cost	Improve freshwater inflows to estuary

Identify and correct significant and unnecessary inter-basin transfers	Inter-basin transfer of water	Route surface water and ground-water to natural outfalls	Cost, land requirements	Improved freshwater inflow characteristics, decreased flooding

Table 4.1. Continued.

Management Option	Issues Addressed	Mode of Operation	Constraints to Implementing	Potential Benefits
Determine and achieve appropriate flows and levels for freshwater systems	Hydrologic loading	Determine optimal range, timing, and levels surface water, and groundwater systems	Cost, technical analysis	Re-establishing acceptable freshwater inflow rates to estuary
Provide treatment for runoff from developed, public lands	Nutrient and hydrologic loading	Treatment improves stormwater quality from roads, other public lands	Financial, location (land requirements in specific locations)	Decreased loadings from stormwater
Require vegetated buffers for tributaries, wetlands, and waterbodies	Stormwater runoff; more natural land cover	Buffers will filter runoff prior to entering wetlands	Regulatory (rules not in place), cost (land not available for development)	Decreased pollutant loadings from stormwater
Promote Florida Yards & Neighbor. measures for source reduction for residences, businesses, and public property	Stormwater runoff	Reducing irrigation, fertilization and pesticide application. decreases loadings from urban lands.	Lack of public knowledge	Decreased nutrient and contaminant loadings from residential areas
Increase level of reuse for landscape irrigation	Stormwater runoff	Reuse reduces landscape nutrient loading needs	Reuse distribution system, social (public acceptance)	Decreases fertilizer contribution to nutrient loading

Extend sanitary sewer to coastal areas now served by septic tanks	contamination of groundwater and surface water supplied by ground water	Removing wastewater effluent from coastal areas reduces chances of water quality impacts	Cost, public acceptance	Reduced nutrient and contaminant loading from septic tanks
Promote the use of agricultural BMPs and development of soil conservation plans	Stormwater runoff; uplands and wetlands to agriculture	BMPs provide water quality treatment to agricultural runoff	Cost, farmers' acceptance or regulatory and enforcement	Reduced nutrient and contaminant loads, and enhanced freshwater flow rates from agricultural lands

Table 4.1. Continued.

Management Option	Issues Addressed	Mode of Operation	Constraints to Implementing	Potential Benefits
Reduce extent of paved surfaces	Stormwater runoff; wetland and upland to urban land use	Reduced pavement reduces runoff quantity and improves quality	Cost, regulatory/ enforcement	Improved surface water quality from urban runoff
Promote compact urban growth	Wetland and upland to urban land use; stormwater runoff	Minimizing urban sprawl reduces spatial extent of impact	Regulatory, public acceptance	Reduced extent of water quality impacts
Develop program to monitor septic tank operation and efficiency	Uplands to urban land use	Improved monitoring will reduce potential for impacts from septic tanks	Cost, public acceptance	Improvements in septic tank operations and efficiency
Ensure that current monitoring of waste water treatment plant effluent disposal is adequate	Point source discharges	Monitoring should be adequate to indicate water quality problems	Cost, plant operators' acceptance	Reduced water quality impacts from waste water treatment plant
Coordinate water quality monitoring programs		Coordinated monitoring will better characterize surface and groundwater	Cost	Better understanding of trends in water quality in basin

Table 4.2. Management options to address wetlands at risk in the Estero Bay Watershed.

Management Option	Issues Addressed	Mode of Operation	Constraints to Implementing	Potential Benefits
Require Upland Buffers/Components for Wetlands	Wetlands at risk, nutrient loading	Protect wetlands from direct impact, preserve important uplands to protect wetlands from indirect impact	Regulations not in place; loss of land use and decreases in land value	Wetland and habitat preservation, nutrient load reduction
Preserve and/or Restore Regional Flowways (hydrologic and habitat corridors)	Wetlands at risk, nutrient loading, flooding	Protect wetlands; preserve habitat connectivity	Cost of land, unwilling sellers	Wetland preservation, flood control
Transfer Development Rights from Sensitive Areas	Wetlands at risk, nutrient loading, flooding	Preserve at-risk habitats from direct and indirect impacts	Existing regulations and codes may prohibit dense development; existing infrastructure may not support dense development	Habitat preservation; prevent increased nutrient loads and runoff

Require Buffer Areas around Tributaries	Wetlands at risk, nutrient loading, flooding	Protect wetlands; preserve habitat connectivity	Regulations not in place; loss of developable land	Wetland and waterbody protection, nutrient and sediment filtering
Require Demonstrated Concurrence With Listed Species Recovery	Wetlands at risk	Prevent direct and indirect impacts to wetlands without full compensation	Regulations not in place; loss of developable land; decreased land values	Wetland and habitat protection and improvement; listed species recovery

"Permitting practices" means establishing permitting practices, codes, and/or regulations that correct existing loading and runoff problems or prevent future loading, runoff, and wetland loss problems. "Structural and active treatment" will require the construction of regional water treatment and attenuation facilities. An option with "best management practice" components would include implementing procedures at the individual homeowner, business, and project level that would aid in nutrient, sediment, and runoff load reductions. "Restoration" and "preservation" would involve restoring or preserving flowways and wetlands at risk. Preservation might consist of actual purchase of sensitive areas, purchase of development rights, or placing a conservation easement over sensitive zones. A management option with a "compensation" component includes either compensation for habitat or loading impacts (e.g. compensatory mitigation) or compensation for the loss of land value or loss of potential use for uplands (e.g. transferred development rights).

4.1. Management Options and Ecological Uncertainty

One of the major concerns that will arise if problems are observed or expected in Estero Bay or its watershed will be choosing management strategies in the face of data gaps and uncertainties. This concern is common to many environmental management issues, however. Foremost in importance is assuring that the management response is of appropriate magnitude for the actual problem observed. Likewise, it is also essential to assure that the observed environmental condition is a true problem and not a random or natural fluctuation.

When management options are chosen and implemented, the intensity of the management response should not be the only criteria considered. Management options will most often be implemented because of an observed or expected ecological change in the bay or the watershed. When an ecological change is detected, the degree of certainty that the detected change is real, and not solely due to chance, must be considered. As such, the intensity of the management response should be tied not only to the magnitude or severity of the ecological change, but also to the degree of certainty that the detected change is real.

Table 4.3 presents a conceptual, decision matrix that integrates the magnitude of the detected change and the probability that the change is due to chance alone (e.g., alpha). The matrix indicates that the intensity of the selected management response is a function of two factors, magnitude of ecological change and probability of change being a natural, random event. If the detected change is relatively large, but the degree of certainty is low (e.g., high alpha), then a less intense management response would be appropriate. If, on the other hand, the detected change is considered to be moderate, but the degree of certainty is high (e.g., low alpha), then a more intense management response would be indicated.

The application of this approach will vary with the specific ecological changes and statistical measures of certainty involved. Nonetheless, the integration of this approach into any Estero Bay and watershed management efforts is recommended.

Table 4.3. Conceptual decision matrix for determining an appropriate management response to detected ecological change.

Probability of Making a Type I Error	Magnitude of Detected Ecological Change		
Alpha	**Small**	**Moderate**	**Large**
0.20	Data Comparison	Discussions among Appropriate Groups and/or Agencies	Increased Sampling
0.10	Discussions among Appropriate Groups and/or Agencies	Increased Sampling	Adverse Impact Evaluation
0.05	Increased Sampling	Adverse Impact Evaluation	Regulatory Summit Meeting

4.2. Regional Surface Water Treatment Facilities

Regional water treatment facilities are an important management option for the Mullock Creek Subbasin Complex and the Imperial River subbasin. These regional treatment and attenuation facilities would generally be large surface water management areas. The facilities would be above ground, surface water reservoirs created by berms and levees and supplied with water by pumps, canals, pipes, and or spillways. Properly located treatment facilities could:

- attenuate nutrient and sediment loadings;
- attenuate freshwater loading;
- provide water supply source (for urban and agricultural users);
- provide habitat;
- increase flood protection (depending on location in watershed);
- create recreation opportunities (fishing, bird watching, etc.);
- provide regional, climatic benefits (frost protection, increased evapotranspiration);
- water conservation; and
- aquifer recharge.

Regional treatment facilities should treat and attenuate large volumes of water while assuring that flood control flows are not impeded. As such, treatment facilities will need to be large, and siting and approval of the facilities will more difficult and controversial than for smaller facilities. Considerations important in siting and construction of a treatment facility are described below.

- The site is large enough to provide required water storage volume.

- The site is near the outfall of a subbasin or subbasin complex so that the facility can treat the majority of the pollutant and runoff load generated by the subbasin.

- The site is adjacent to, or near, an existing primary-canal or watercourse (to maximize management flexibility and minimize water transmission costs (e.g., pumps, pipes, new canals, etc.).

- The site is at low elevation to maximize storage capacity, minimize costs associated with the construction of water transmission infrastructure, and prevent the facility from flooding or raising the water tables on adjacent property.

- The site is owned by a willing seller.

- In order to minimize impacts and regulatory constraints, the site has few or no valuable wetland or upland habitats and no protected plant or animal species.

- ! The site is distant from heavily-developed urban areas, so as to minimize socioeconomic impacts (though some facilities could provide complimentary land uses like lake view, recreation, and buffer preserves that increase the value of adjacent properties).

- ! The property's value for urban or agricultural development is limited or impaired.

Though the purpose of regional treatment facilities is to restore or improve natural hydrologic regimes and nutrient and sediment loading characteristics, adverse environmental impacts associated with facility construction will need to be avoided, minimized, and mitigated. Avoidance and mitigation will be complicated by the fact that many parcels with the fewest environmental constraints have already undergone or been targeted for development. The flexibility of Federal, State, and local regulatory programs is often limited when benefits accrue in a different habitat or to a different species than that being impacted (e.g. freshwater wetlands being dredged in order to improve estuarine water-quality for example). Therefore, environmental sensitivity should be an important factor when siting facilities.

Land parcels available for treatment facility siting will be a factor in determining the type of facility that is constructed. Because of the region's high water tables, above- round surface water reservoirs may be required. If constructed in uplands, such reservoirs would be created by the excavation and construction of external and internal levees and berms. Such a facility would also require infrastructure (like pumps and conveyance and control structures) to transport and manage water flows. The facility would require the ability to store, transfer and/or release variable volumes of water efficiently and rapidly. Upland sites offer the benefit of additional storage in excavated areas. In wetland sites, the water table is frequently at the surface and this additional storage is not present even after excavation.

4.3 Demonstrating Concurrence with Load Reductions

Demonstrating concurrence with load reductions would require that projects contribute to reducing loadings within the watershed. An important provision of this option would be the requirement that new projects treat problem runoff that enters their sites in the existing condition rather than routing this runoff through or around the sites. The cost of this option would accrue primarily to private interests.

4.4 Greater Treatment and Attenuation

This option would require greater treatment and attenuation of runoff generated by new or substantially modified land development and infrastructure (roads, etc.) projects. Greater treatment could occur through a variety of stormwater-treatment technologies, best management practices that decrease nutrient runoff, or a combination of the two. Implementing this option would require that existing rules and regulatory practices be modified. The majority of the cost associated with this option would be born by private landholders, though public facility and infrastructure projects would bear a proportionate amount of the cost.

4.5 Mullock Creek Subbasin Complex

The Mullock Creek Subbbasin Complex (including the Mullock Creek, Ten-Mile Canal, Hendry Creek, and Six-Mile Cypress Slough subbasins) is dominated by the Ten-Mile Canal and Six-Mile Cypress Slough waterways (Figure 4.1). All four secondary basins in this complex eventually discharge into Estero Bay through the outfall shared by Mullock Creek and Hendry Creek. The Ten-Mile Canal also discharges through Mullock Creek. The ideal treatment facility location in this basin complex will be far enough downstream to treat the maximum amount of water, far enough upstream to avoid impacting the wetlands surrounding Estero Bay, and large enough to attenuate the large volumes of flow that will be experienced at a downstream site.

Three management options for the subbasin complex are evaluated in Table 4.4. This table and those that follow, list scores for management options according to several criteria. The regional treatment facility is predicted to have very good nutrient, sediment, and runoff attenuation, but

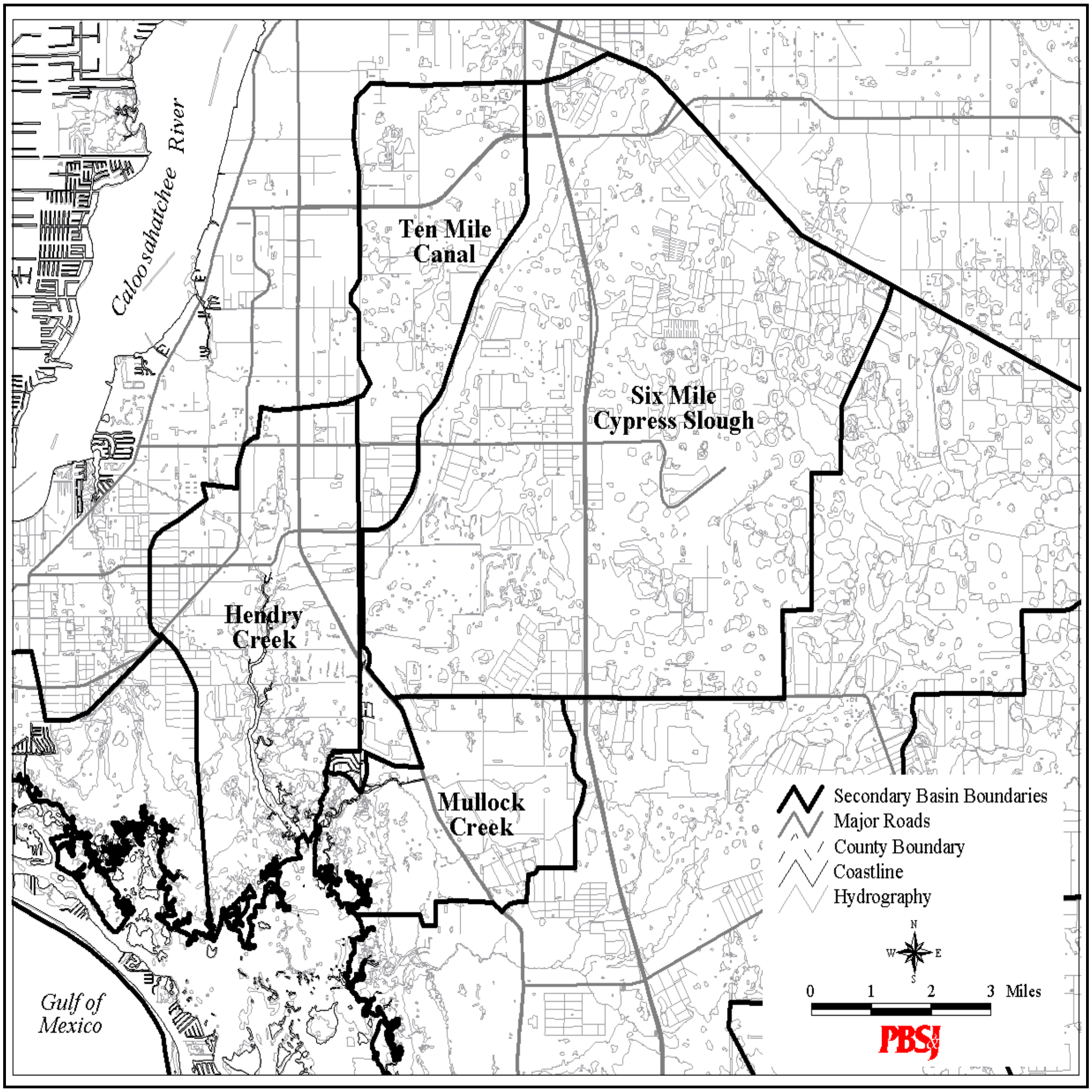

Figure 4.1. The Mullock Creek Subbasin Complex composed of the Hendry Creek, Mullock Creek, Ten-Mile Canal, and Six-Mile Cypress subbasins.

Table 4.4. A comparison and evaluation of three Mullock Creek Subbasin-Complex corrective management-options.			
Criterion	**Option 1** **Regional Treatment Facilities**	**Option 2** **Require Concurrency with Load Reduction**	**Option 3** **Require Greater Stormwater Attenuation and Treatment**
Nutrient Load Reduction	[[[	[	[
TSS Load Reduction	[[[	[	[
Hydrologic Load Reduction	[[	[	[
Flood protection	,	[	[/0
Habitat	0	0	0
Permitting	0 / ,	0	0
Sociopolitical	0 / ,	0 / ,	0 / ,
Public Cost	, ,	0 / ,	0 / ,
Private Sector Cost	0	,	,
Ease of Implementation	,	[/ ,	[/ ,

[[[[= better
0 = neutral or equal positive and negative
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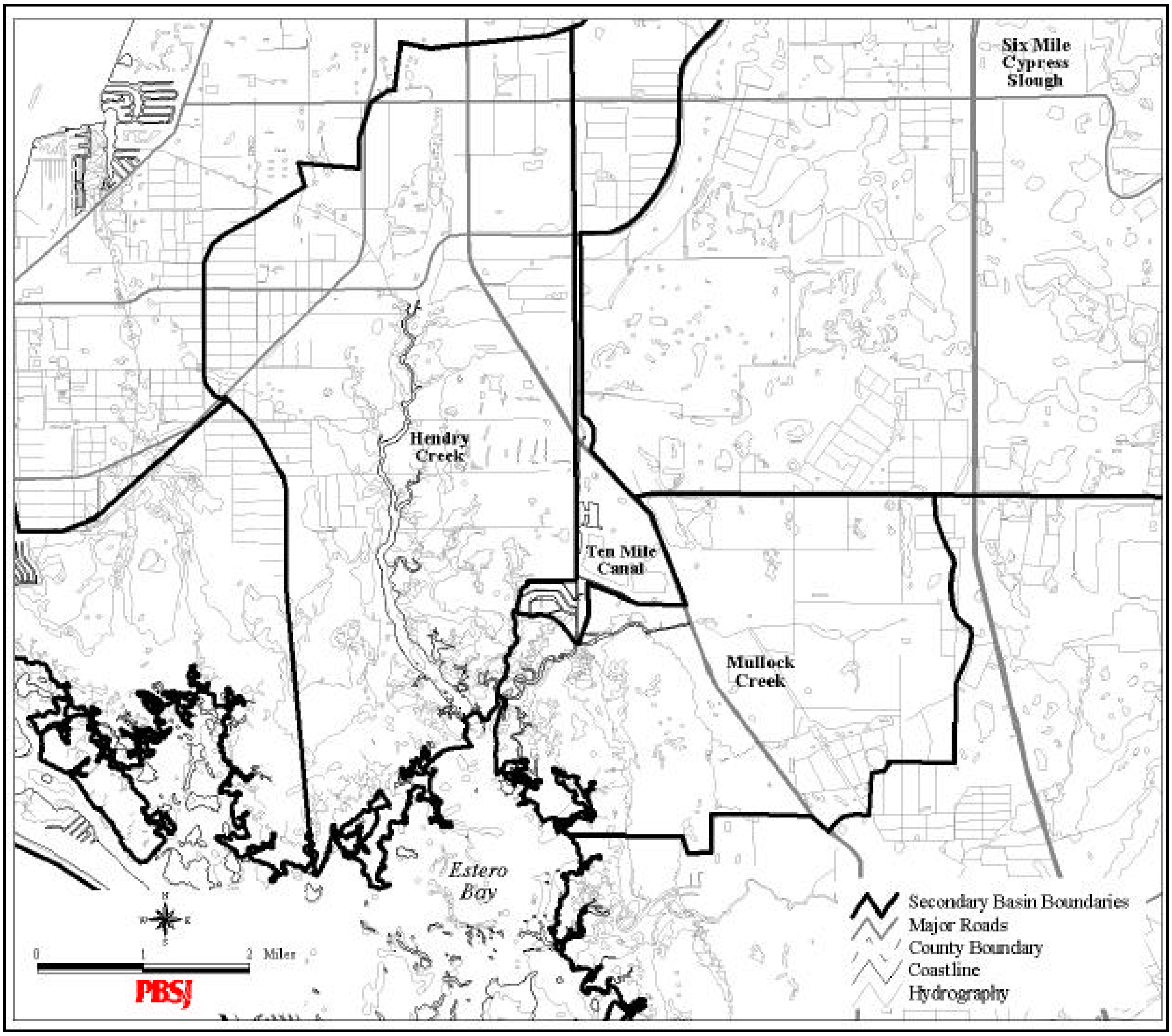

Figure 4.2. The downstream areas of the Mullock Creek Subbasin Complex.

the option is also expected to be expensive. The lower portions of the basin-complex (Figure 4.2) are heavily developed, and large tracts of open land are limited. If the regional treatment facility option is implemented it will probably take the form of several smaller facilities (rather than a few large facilities) in order to meet the limitations of available land. There are several borrow pits in the lower subbasin complex that could serve as treatment sites, but several are already used for project specific stormwater attenuation and treatment. The Lakes Park borrow pits in the Hendry Creek subbasin are a suitable site for a treatment facility, however. Such a facility might not be compatible with the park's current recreational uses.

The other two options, requiring project concurrence with load reduction goals and increasing runoff treatment and attenuation for new development projects, are limited by the fact that so much of the lower basin complex is already developed. Though some retro-fitting is possible when long term development plans are revised or infrastructure is maintained, treatment options are limited by the amount of open land. These two options are much less costly (in terms of public expenditures), but they will likely meet some opposition from owners of undeveloped property.

4.6 Imperial River Subbasin

The Imperial River subbasin is a large, watershed feature that discharges through a small corridor, the Imperial River (Figure 4.3). Areas surrounding the Imperial River were the site of severe flooding in 1995. Much of this flooding has been attributed to an increase in the contributing basin size and runoff-budget and constrictions within the outfall corridor (Johnson Engineering Inc. et al., 1998). The Federally-sponsored Southern CREW critical project is proposed to improve flooding problems in this area.

Table 4.5 evaluates three management options for the Imperial River Basin. These options are:

- regional treatment facilities;
- restoring historic flowways; and
- requiring greater stormwater attenuation and treatment.

There is more land available for treatment facilities in this basin than in the Mullock Creek Subbasin Complex, but the tertiary basin farthest downstream in the Imperial basin is heavily developed with a limited amount of open land. This tertiary basin is also a high priority basin. Two other high priority basins, located immediately upstream have substantial areas of open and fallow agricultural land that are suitable for treatment facilities. Large portions of these tertiary basins are included in the Southern CREW critical project as well.

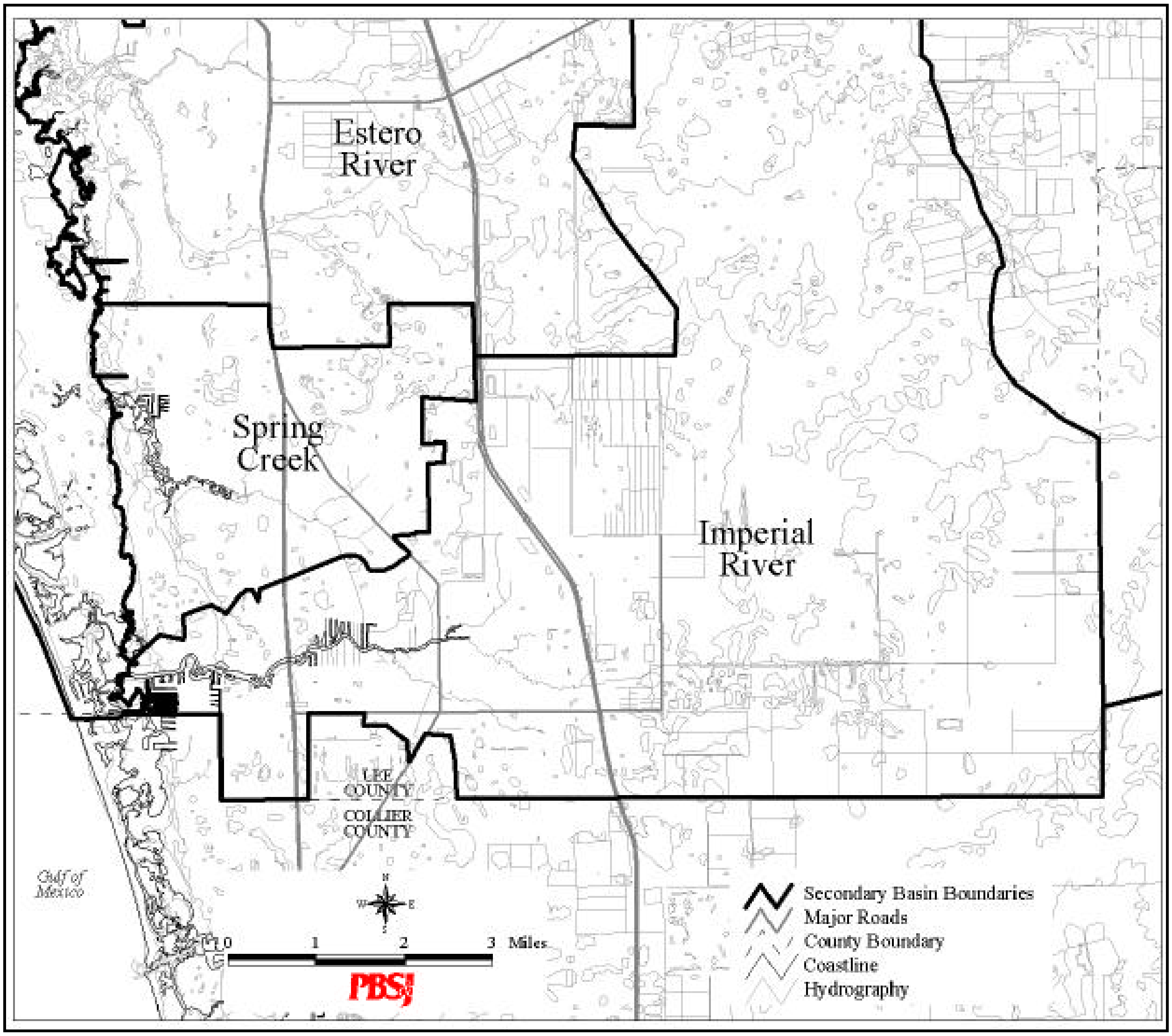

Figure 4.3. The downstream portions of the Imperial River Subbasin.

Table 4.5. A comparison and evaluation of three Imperial River Subbasin corrective management options.

Criterion	Option 1 Regional Treatment Facilities	Option 2 Restore historic flowways	Option 3 Require Greater Stormwater Attenuation and Treatment
Nutrient Load Reduction	[[[	[/0	[[
TSS Load Reduction	[[[	[/0	[[
Hydrologic Load Reduction	[[[	[[	[[
Flood protection	,	[[	[/0
Habitat	0	[[	0
Permitting	,	0	0
Sociopolitical	0 / ,	[/ 0 / ,	0 / ,
Public Cost	, ,	0 / ,	0 / ,
Private Cost	0	0	, / , ,
Ease of Implementation	, ,	0	[/ 0

[[[[= better
0 = neutral or equal positive and negative
, , , , = poor
[/ 0 / , , [/ 0, 0 / , = mixed

The option of restoring historic flowways is somewhat constrained by the large number of property owners with small parcels in the historic flowways. It should be possible to create a flowway system that functions more like the historic condition than the current flow patterns. This restoration should improve habitat quality in the area, although the restoration is unlikely to reach its maximum potential for flood control and nutrient attenuation. In the absence of constructed, active, regional treatment facilities, these goals can probably be reached only at the expense of the wetlands in the restoration area. Maximum attenuation and treatment could be achieved by treating the eastern Imperial River subbasin's regional wetland system as a large treatment facility. The potential that this use could adversely affect wetland hydroperiods will make permit approval for such a proposal very difficult and costly.

Requiring greater treatment and attenuation of stormwater in this area appears to be a good option. The flooding problems in the subbasin may have already made greater attenuation a necessity. This option will likely be resisted by some owners of undeveloped property and encouraged by property owners in flood-prone areas. Most of the cost for implementing this option will fall on the private sector, but public infrastructure and facilities projects will also bear a portion of the cost.

4.7 Wetlands at Risk

Three options for addressing wetlands at risk in the Estero Bay Watershed are evaluated in Table 4.6. These options are:

- Requiring upland buffers and upland-preserve components for wetlands;
- Transferring development rights from sensitive areas in and around wetlands; and
- Requiring the projects in listed species habitat to demonstrate concurrency with (or contribute to) listed species recovery.

Some form of spatial or physical buffer is a requirement for most development permits. This option would require a significantly larger buffer of undeveloped habitat around wetlands. These buffers would serve to:

- protect wetland interiors from urban and agricultural land uses;
- decrease negative ecological edge effects;
- dreserve the upland-wetland ecotone and resulting, positive, ecological edge effect;
- filter some runoff; and
- provide both habitat and habitat corridors.

The Estero Bay Watershed is a mosaic of uplands and wetlands. Because of the large number of wetlands in the landscape, requiring substantially larger, upland buffers for wetlands could notably reduce the amount of developable land on many pieces of property. While nature preserves are frequently marketed as development amenities, loss of development land will likely meet strong opposition from many property owners.

Transferring development rights from sensitive areas could be implemented as an effort into itself or in combination with either of the two other conservation options evaluated here or one of several loading reduction efforts. Transferring development rights will most likely result in increased development densities elsewhere in Lee County. Infrastructure limitations may constrain development where these increased densities will occur. Furthermore, market demand for both particular locations and specific development densities will determine if development rights transfers are perceived as benefits or burdens by stakeholders. Development rights transfers still offer the opportunity to improve the perception of other management options, however.

Table 4.6. A comparison and evaluation of three conservation management options.

Criterion	Option 1 Upland Buffers/Components for Wetlands	Option 2 Transfer Development Rights from Sensitive Areas	Option 3 Require Demonstrated Concurrency with Listed Species Recovery
Nutrient Load Reduction	[/0	[/0	[/0
TSS Load Reduction	[/0	[/0	[/0
Hydrologic Load Reduction	[/0	[/0	0
Flood Protection	[	[	0
Habitat	[[	[[	[[[[
Permitting	[	[	[
Sociopolitical	0	[[	[/0
Public Cost	0	,	0
Private Cost	,	0/ ,	, ,
Ease of Implementation	,	[/ 0 / ,	, ,

[[[[= better
0 = neutral or equal positive and negative
, , , , = poor
[/ 0 / , , [/ 0, 0 / , = mixed

Requiring that projects in or adjacent to listed species habitats demonstrate contributions to listed species recovery may be the most controversial of the three options. Proving concurrence with listed species recovery may also require that significant areas of otherwise developable land be set aside for conservation. While it is possible that net losses in habitat area or acreage can be compensated for by habitat enhancement, it is more difficult to prove that a net loss in habitat acreage contributes to the recovery of a listed species. Losses of development land will create significant opposition to this management option. This management option will discourage excessive efforts to preserve isolated habitat fragments that no longer benefit listed species recovery (as opposed to short term support of isolated individuals). This should provide some compensation for losses in development land.

4.8 Summary

When Estero Bay Watershed tertiary basins are ranked according to a suite of water quality related factors, it become apparent that the majority of the basins (fourteen of sixteen) most at risk for water quality problems discharge to the Bay through either the Mullock Creek-Hendry Creek outfall or the Imperial River. These secondary basins also contain the majority of tertiary basins in terms of both number and area. These factors indicate that the Mullock Creek Basin Complex (Mullock Creek, Hendry Creek, Ten-Mile Canal, and Six-Mile Cypress Slough subbasins) and Imperial River basin should be the primary locations for loading-related management efforts.

If problems are observed in the Estero Bay Watershed, the most effective water treatment and attenuation efforts will involve a combination of techniques. These techniques will range from best management practices implemented by individual homeowners to the construction of regional treatment facilities. Scarcity and cost of suitable land for publicly constructed treatment facilities will be major constraints in implementing this management option. Cost and the loss of otherwise developable land will be the major constraints to implementing more stringent water treatment and attenuation requirements for individual, development, and infrastructure projects. Cost and the loss of otherwise developable land will also be major constraints to reducing future impacts and degradation to wetland habitats outside of conservation areas.